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map on which all propagation areas are marked and numbered, and to cost-sheet records, will indicate whether any change of method of procedure is advisable and whether or not the work is more costly than is necessary. These records will also enable the health officer in charge to make improvements intelligently.

Campaigns for mosquito control in any locality will generally succeed or fail according to whether or not the person or persons directing the work take the trouble to understand and become interested in the details pertaining to the field work. Much depends upon the frequent and intelligent inspection of the work as actually being done in the field. Some mosquito-control work has been undertaken which would have been far more successful if those directing the work had spent more time out in the field where the work was thought to be progressing satisfactorily. The officers who direct mosquito control, in considering costs must keep in mind the unit and total cost of the work during a long or definite period of time and not think only of the present season.

RAT PROOFING THE PUBLIC DOCKS OF NEW ORLEANS.

A REPORT ON ITS POSSIBILITY AND COST.

By H. P. Letton, Sanitary Engineer, United States Public Health Service.

The State of Louisiana has taken over practically the entire river front of New Orleans for the good of the general public. The control of this property is vested in the Board of Commissioners of the Port of New Orleans, popularly known as the Dock Board. This board has very extensive powers. It may issue bonds for the construction and operation of warehouses, wharves, and landings, may expropriate property, and in short may take any practical and necessary step for increasing the efficiency and economy of the port's facilities. The board is appointed by the governor and serves without pay.

The public wharves extend from Louisiana Avenue to Pauline Street, their total length being 4.82 miles. They are continuous except for ferry landings at Esplanade Avenue, Canal Street, Terpsichore Street and Jackson Avenue, these breaks aggregating 0.30 miles. In about three-fourths of their length the wharves are covered by steel sheds, which have an aggregate length of 3.77 miles. These sheds rest either wholly on the wharf proper or partly on the wharf and partly on the land back of the wharf. Above Louisiana Avenue and extending to Napoleon Avenue, a distance of about a mile, are the Stuyvesant Docks owned by the Illinois Central Railroad. These docks are discussed in a separate report. Above Napoleon Avenue there are being constructed a reinforced concrete wharf and cotton warehouses, which will form part of the public dock system.

The wharves proper are built on the river slope of the levee and consist of a timber floor resting on a piling substructure. The floor of the wharf is about 19 feet above mean low water. At the rear of the wharf is a sheet piling bulkhead 8 inches in thickness and extending to a depth from the wharf floor of from 20 to 40 feet. This bulkhead acts as a wave breaker to prevent washing of the levee and as a retaining wall to support an earth fill in the rear of the wharf. With the exception of the floor planking on all the wharves, all but 0.46 mile are built of creosoted material. In the rear of the bulkhead the floor is built of untreated material, and for the most part rests on timber cribs which raise it about 2 feet above the ground. In many cases, however, the floor rests directly on the ground, being fastened to sills imbedded in the earth. In most of the sheds the earth fill behind the bulkhead comes very near the floor elevation, but in a few cases there is a depth of from 10 to 15 feet next to the bulkhead, and the ground slopes back a distance of about 40 feet before reaching a point near the floor level. The distance from the floor to the earth in front of the bulkhead, known as the "batture," varies from 4 to 18 feet. Along the greater part of the wharves, however, it is from 10 to 15 feet. A clear idea of the construction can be obtained from drawing 1.

The space below the floor behind the bulkhead constitutes almost an ideal rat harbor. It is dry and dark, which makes it favorable for the harboring and breeding of the *Mus norvegicus*. The floor is for the most part laid with three-fourths-inch openings between the boards. In many cases these openings are larger, and throughout the whole system of shed floors there are thousands of convenient holes which will allow the passage of rats to the floor of the sheds. Along the rear of the sheds there is an open space, as shown in figure 1. In several of the sheds sloping driveways lead in from the street, and these are also open at the sides. The supply of food is abundant. Numerous commodities, such as flour, oil cake, rice, wheat, and other grains are handled in sacks. These sacks are continually being broken or torn by hooks, and much food falls through the cracks in the floor to the ground beneath. At the Erato Street, Press Street, and Pauline Street sheds large quantities of fruit, mostly bananas, are handled, and there is a condiderable waste, which forms food for rats. The space below the floor is of special importance as regards plague, as the large amount of dusty matter there is ideal for the breeding of fleas.

At those docks having the shed entirely on the wharf the only harboring places for rats are in the earth behind the bulkhead or in openings around where the bulkhead joins the floor.

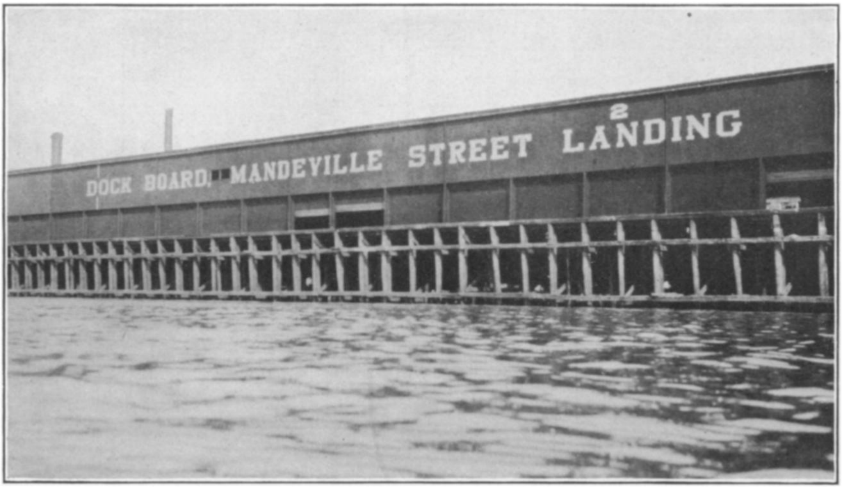


FIG. 1.—TYPICAL WHARF AND SHED AS SEEN FROM RIVER.

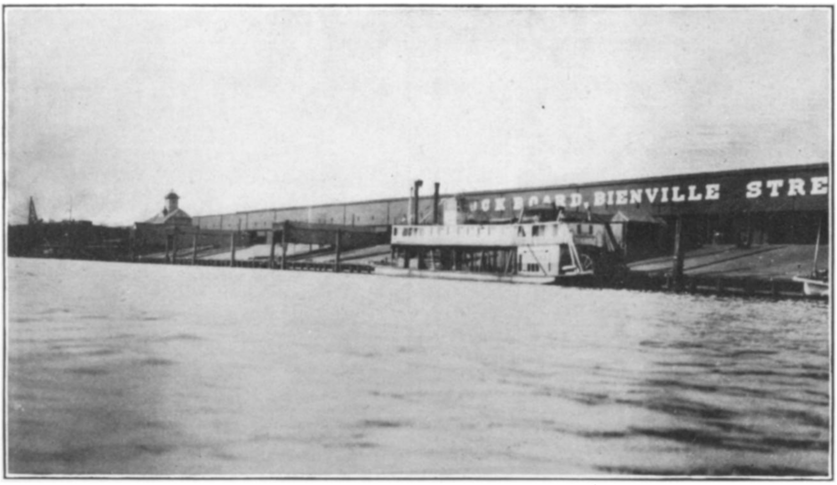


FIG. 2.—APRON OR STEAMBOAT WHARF.

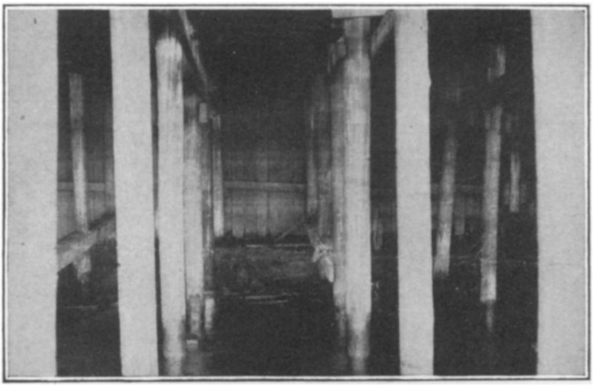


FIG. 3.—VIEW BENEATH WHARF SHOWING PILING, BULKHEAD, AND BATTURE.

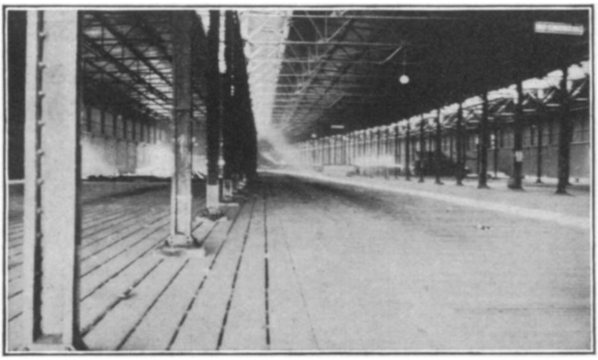


FIG. 4.—INTERIOR VIEW OF SHED SHOWING OPENINGS IN FLOOR. THE BULKHEAD IS ON THE RIGHT SIDE OF THE DRIVEWAY NEAR THE ROW OF COLUMNS.

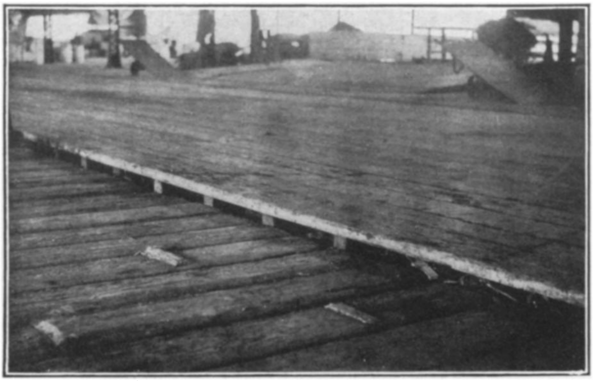


FIG. 5.—VIEW SHOWING OPENINGS IN SHED FLOOR.

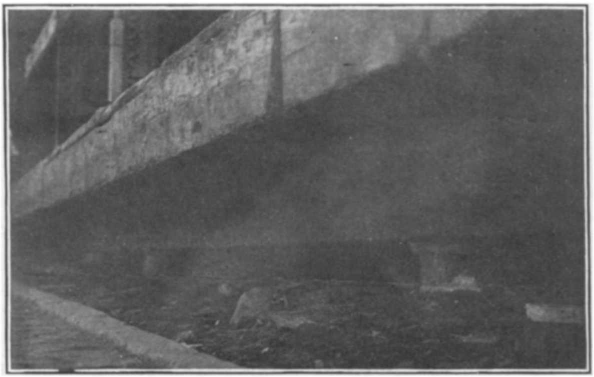


FIG. 6.—REAR OF SHED SHOWING OPENINGS BENEATH FLOOR.

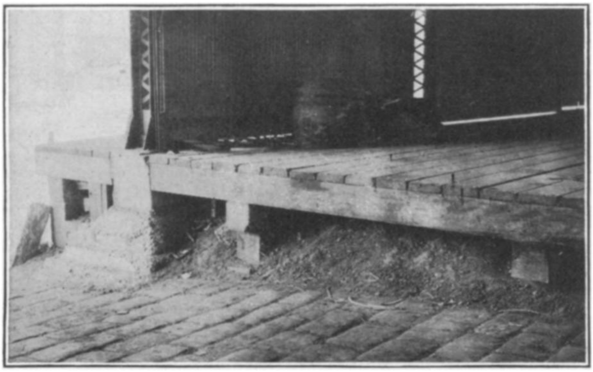


FIG. 7.—DRIVEWAY SHOWING OPENING BENEATH FLOOR.

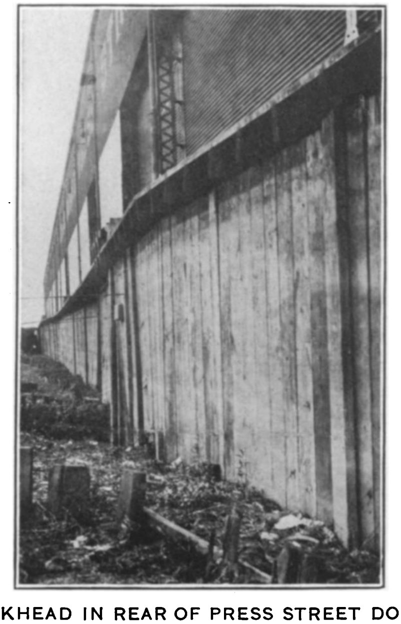


FIG. 8.—BULKHEAD IN REAR OF PRESS STREET DOCK, SHOWING IRREGULARITIES DUE TO EARTH MOVEMENT.

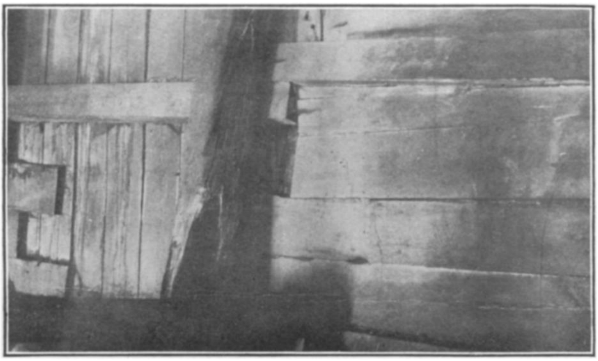
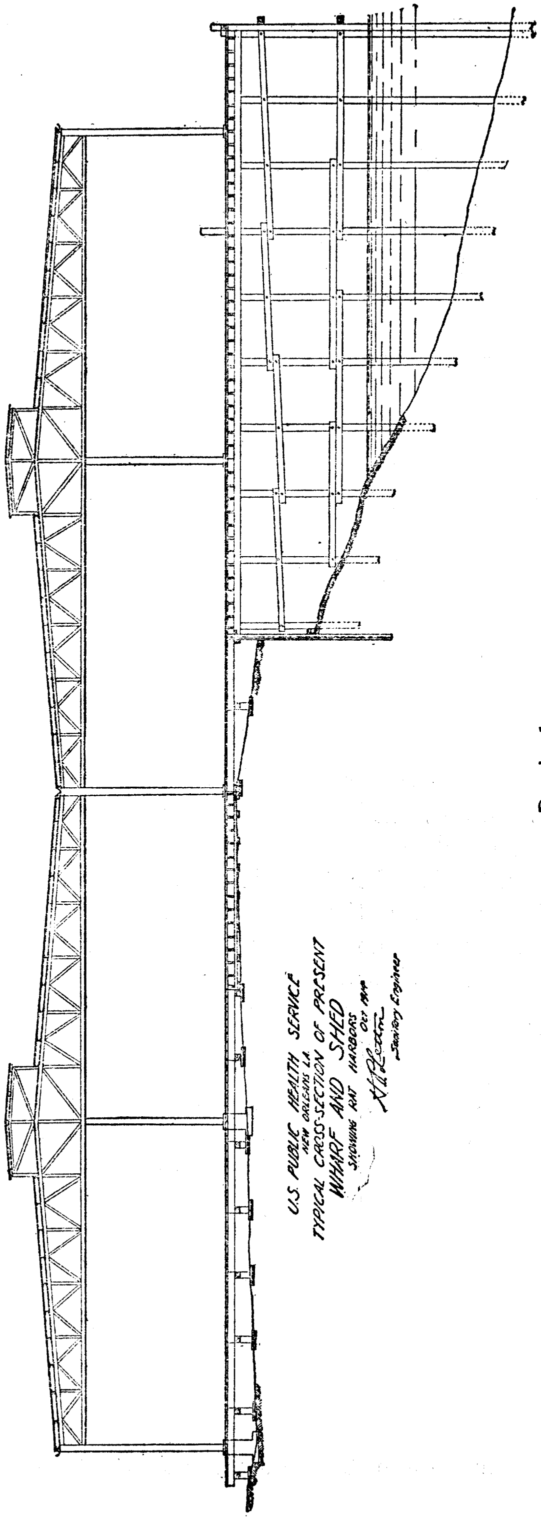


FIG. 9.—VIEW SHOWING PATCHED AND ROTTED CONDITION OF DUMAINE STREET BULKHEAD.

FIG. 10.—FIRE WALL AT LOWER END OF STUYVESANT DOCKS. THIS IS A GRAVITY CONCRETE WALL SUPPORTED ON PILING.


U.S. PUBLIC HEALTH SERVICE
NEW ORLEANS LA.
TYPICAL CROSS-SECTION OF PRESENT
WHARF AND SHED
SHOWING RAT HARBORS
OCT 1914
Sanitary Engineer

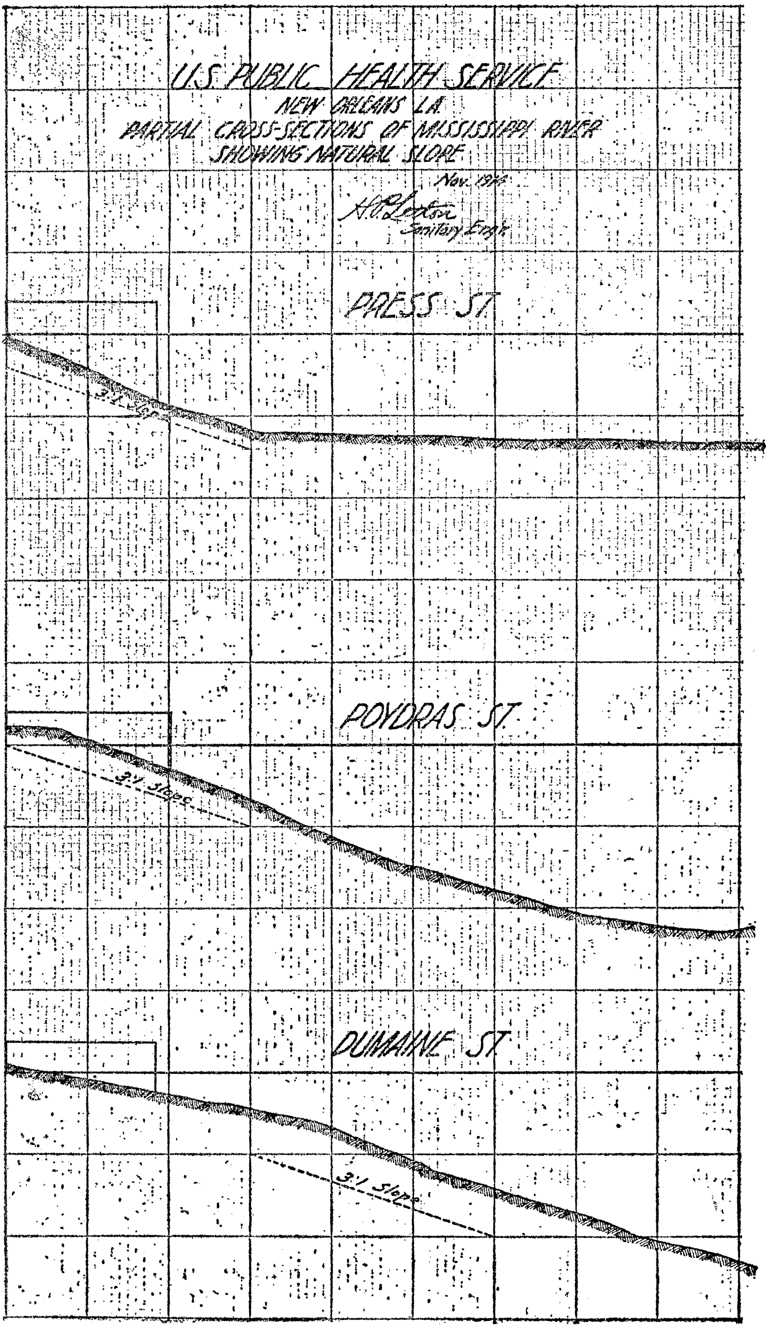
Drawing 1.

As a general rule, rats will not burrow in the batture because it is generally quite wet or muddy. In a few cases, however, the batture runs to within a few feet of the floor, and in such cases it is dry except during extreme high water, and undoubtedly harbors some rats. In other cases there is an old bulkhead in front of the present one, extending several feet above the batture, and the earth between these bulkheads probably contains rats.

The necessary steps for making the docks practically rat proof are self-evident, and it is only the ways and means which require discussion. The essential factors are as follows: (1) The space beneath the floor back of the bulkhead must be eliminated and a rat-proof floor and protecting wall along the rear constructed. (2) There must be a rat-tight bulkhead making a tight fit with the floor. (3) The floor of the wharf proper out to the edge of low water should be made tight. (4) Rat-proof walls should be constructed at the ends of certain wharves from the bulkhead to low water to prevent the access of rats beneath the wharf except by going over the face.

It became evident early in the investigation that most of the work which would be required in the rat proofing of the wharves would be of great economic value to them. The wooden floors behind the bulkhead have a relatively short life. In fact, in a few sheds where the floors were laid on mud sills only four years ago they have become so rotten that the renewal of large areas is necessary. By replacing the present floor with one of concrete or asphalt the initial cost would be greater, but the annual cost would be much smaller. The fire risk would also be considerably decreased, as the only easily combustible material would be the wharf proper. Another fact of extreme importance to the shippers is the lessened cost of handling freight over smoother floors. In many places where at present three men are required to move a truck, two would be sufficient with smooth floors. As proof of this saving it may be said that following the rat proofing of a railroad warehouse by the installation of a concrete floor, the official in charge stated that there would be a saving of $5,000 per year in labor of handling freight. Since the cost of the work was only $10,000, its saving can easily be seen. Another point of special importance to shippers is the fact that there would be much less loss of material with tight smooth floors than with the present ones. That this loss is an important one can be seen by going beneath the Poydras Street Dock after one or more coffee ships have unloaded their cargo. A concrete or asphalt floor could be easily swept or washed clean and would not be dusty, as are the present floors.

The problem of putting into the dock structures any permanent and nonelastic substance, as concrete, is greatly complicated by the fact that the foundations are extremely unstable. The docks, as stated, are built on the river slope of the levee. The soil is alluvium, which is extremely fine and which when saturated with water takes


U.S. PUBLIC HEALTH SERVICE
NEW ORLEANS LA.
PARTIAL CROSS-SECTIONS OF MISSISSIPPI RIVER
SHOWING NATURAL SLOPE
Nov. 1914
H. P. Letton
Sanitary Engr.
PRESS ST.
3:1 Slope
POYDRAS ST.
3:1 Slope
DUMAINE ST.
3:1 Slope

Drawing 2.

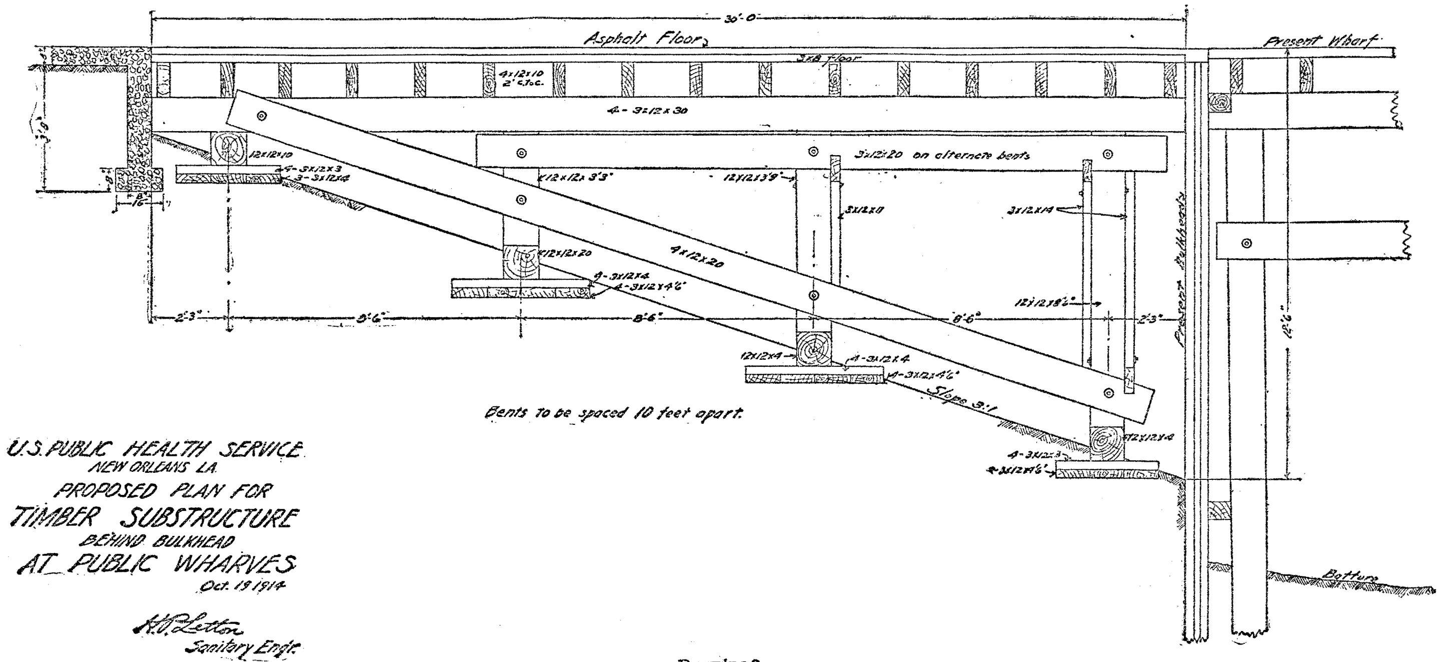
on the characteristics of a liquid. Its natural slope is about 3 : 1, as is seen from the cross sections shown in drawing 2. During periods of high water the current beneath the wharves is practically nil, and at such times there is a large amount of sediment deposited at that point. When the river falls, this deposited material tends to take on its natural slope, with the result that the wharf itself is sometimes moved out. The greater part of the piling, being unbraced for half or more of its length, has very little power to resist a lateral movement. This tendency to move is very much aggravated by the fact that in most of the wharves the earth behind the bulkhead is piled almost to the floor level, thus making the bulkhead act as a retaining wall. Following a period of high water, when the fill behind the bulkhead is saturated with water, the outward pressure on the bulkhead which is counteracted by the wharf is very great.

That there has been a movement of this kind at some of the docks is very evident, its effect being most noticeable at the Press Street, Toulouse Street, Celeste Street, and Mandeville Street sheds.

It is evident that, in order to prevent the movement of the wharves, either the bulkhead must be tied back to the levee so as not to press against the wharf or the load must be removed from the bulkhead by excavating in the rear.

The present bulkhead is for the most part in good condition, and except for occasional openings where an old pile or other obstruction was encountered in driving it is practically rat proof, since a rat will not gnaw through 8 inches of wood. Keeping in mind, however, the idea of permanent construction, an investigation was made as to the feasibility of a concrete bulkhead. Because of the nature of the problem it was thought probable that some form of reinforced-concrete sheet piling would be the most feasible type of construction to serve the purpose. Piling of any kind can not be used for replacing the present bulkhead because the sheds do not give sufficient headroom for driving. At those wharves where the bulkhead is in poor condition, as at Dumaine Street, it will shortly be necessary to remove the shed and rebuild the entire wharf, and at such points a concrete bulkhead could be used if its construction is possible from an economic standpoint.

A complete study of the possibilities of concrete sheet piling was made, and it was found that the construction of a stable wall of this kind was out of the question because of its cost. The design of a gravity wall of plain concrete supported by wooden piling cut off below the low-water line, similar to the fire walls at the Stuyvesant Docks, was then considered, and it was found that a wall of this kind could be built for about three to four times the cost of constructing the present type of bulkhead. Although a wall of this type would be practically permanent, while the present type has a life of


30'-0"
Asphalt Floor
Present Wharf
3x8 floor
4x12x10 2' c.to c.
4-3x12x30
3x12x20 on alternate bents
12x12x10
4-3x12x3
3-3x12x4
12x12x3'3"
12x12x3'9"
3x12x8
3x12x14
4x12x20
12x12x20
4-3x12x4
4-3x12x4'6"
12x12x8'6"
12x12x4
4-3x12x4
4-3x12x4'6"
Slope 3:1
12x12x4
4-3x12x3
4-3x12x4'6"
2'-3"
9'-6"
8'-6"
8'-6"
2'-3"
Present Bulkheads
18'-2"
Bottom
3'-0"
8"
8"
16"
Bents to be spaced 10 feet apart.
U.S. PUBLIC HEALTH SERVICE
NEW ORLEANS LA.
PROPOSED PLAN FOR
TIMBER SUBSTRUCTURE
BEHIND BULKHEAD
AT PUBLIC WHARVES
Oct. 19 1914
H.O. Letton
Sanitary Engr.

Drawing 3.

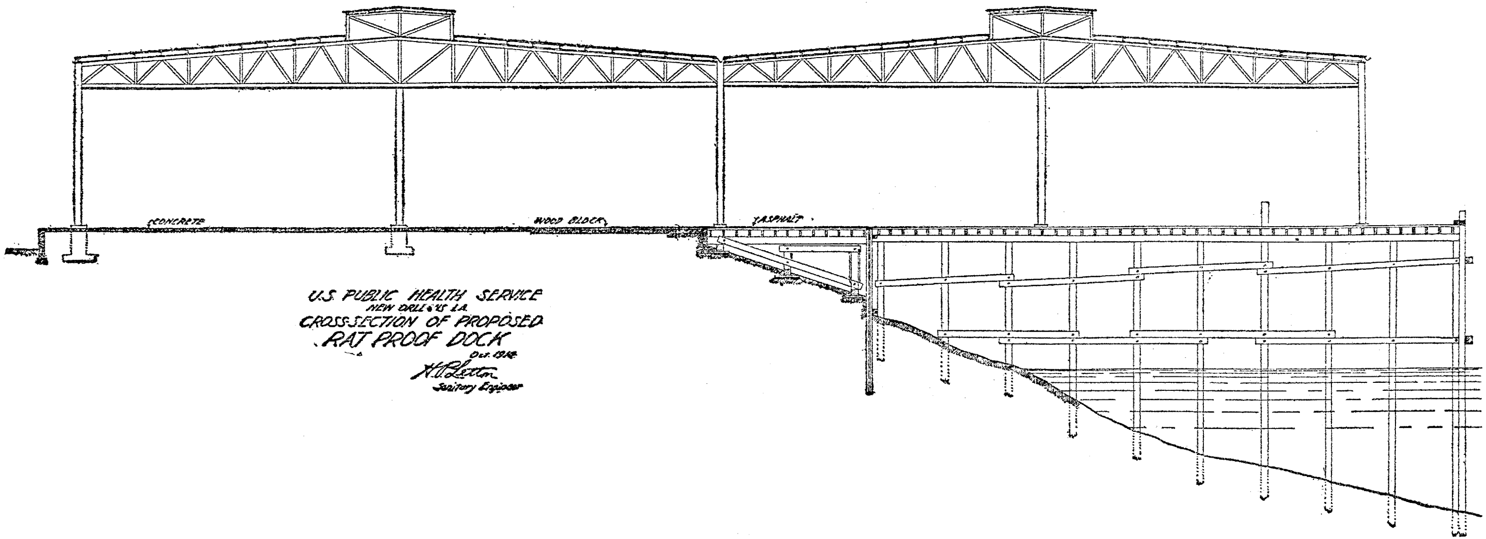
only about 30 years, the annual cost of interest plus sinking fund would be considerably greater.

If we assume that the present bulkhead is to be left intact, as must be the case at present at most of the docks, then the problem of removing the load from it must be taken up. The plan proposed for this was suggested by the engineer of the Dock Board, but his idea has been more or less modified by the writer to make it conform to rat-proofing requirements. It is in brief as follows: Next to the bulkhead the earth is to be removed for a depth of about 12.5 feet and from here is to slope back on a 3:1 grade, a horizontal distance of 30 feet. This excavation will in almost every case reduce the lateral thrust on the bulkhead and wharf to a negligible amount. It is proposed that on this slope there be constructed a framed timber structure in bents 10 feet apart resting on timber spread-footings; this structure to be built wholly of creosoted material and to be well braced. The details of the bents are shown in drawing 3. It is proposed that on the floor which covers the substructures there be laid a coating of asphalt or mastic approximately 2 to 2.5 inches thick which shall have its top at the same elevation as the floor of the present wharf, and which shall make a tight joint with this floor and with the top of the bulkhead. In lieu of using asphalt the Dock Board prefers to use wood blocks creosoted by the Reuping process. The reason for this change is that there is some difference of opinion about the lasting quality of the asphalt.

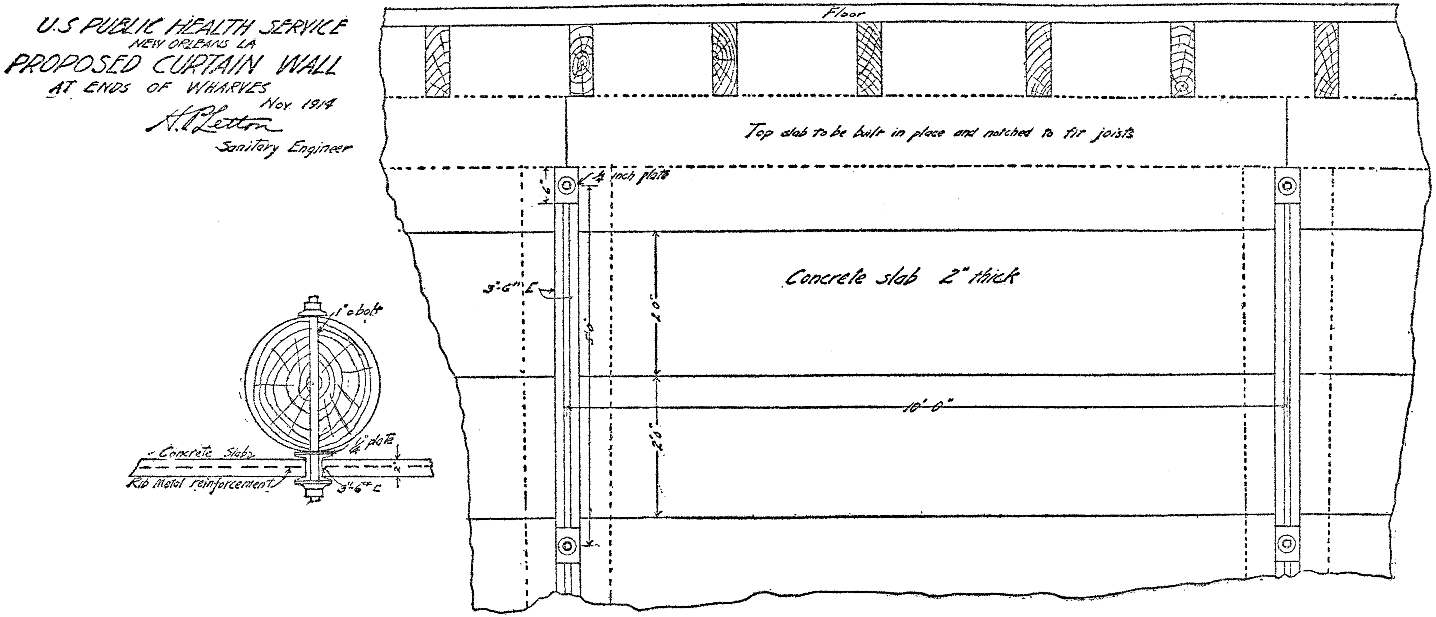
Along the land side of this structure there is to be a concrete wall extending from the floor level to a depth of about 2 feet below the surface of the earth, as shown in drawing 3. At the ends of each shed the earth is not to be excavated the full depth, but will slope on a 3:1 grade toward the center of the shed until it merges with the regular excavation. At the ends of the shed a wall similar to that behind the timber framework will run from that wall to the bulkhead and will make a tight joint with it. This construction will make a closed box which will be rat-tight. By dividing it by light cross walls into sections it could be easily fumigated at any time desired, thus killing all rats which had effected an entrance in any manner.

It is proposed to construct a concrete wall extending from the floor level to 2 feet into the ground along the ends and rear of the sheds, this wall also to extend in along the sides of any sloping driveways. The area between these walls and the wall back of the timber structure is to be filled with earth, and on this is to be laid a floor of concrete or asphalt macadam. It is proposed to lay a driveway through the length of the shed of creosoted wood blocks on a concrete base.

A cross section of a dock reconstructed in accordance with the foregoing plan is shown in drawing 4.


CONCRETE
WOOD BLOCK
ASPHALT
U.S. PUBLIC HEALTH SERVICE
NEW ORLEANS LA.
CROSS-SECTION OF PROPOSED
RAT PROOF DOCK
Oct. 1914
Sanitary Engineer

Drawing 1.


U.S. PUBLIC HEALTH SERVICE
NEW ORLEANS LA
PROPOSED CURTAIN WALL
AT ENDS OF WHARVES
Nov 1914
H. P. Letton
Sanitary Engineer
Floor
Top slab to be built in place and notched to fit joists
1/4 inch plate
6"
3'-6" L
5'-0"
2'-0"
2'-0"
10'-0"
Concrete slab 2" thick
1" ⌀ bolt
1/4" plate
Concrete Slab
2"
Rib Metal reinforcement
3'-6" L

Drawing 5.

In order to prevent to a large extent the access of rats to the batture in front of the bulkhead, there should be constructed curtain walls at the ends of certain wharves. It is proposed for this purpose to use thin slabs of reinforced concrete held in place by **I** beams, as shown in drawing 5.

The following table gives the estimated cost of rat proofing the entire water front which is served by the public wharves:

Name of dock.	Estimated cost.	Name of dock.	Estimated cost.
Pauline Street	$1,718.64	Julia Street	$100,663.00
Louisa Street	6,598.90	St. Joseph Street	4,774.00
Clouet Street	66,951.72	Erato Street	12,211.32
Press Street	200.00	Robin Street	105,547.23
Mandeville Street	6,581.66	Celeste Street	55,383.91
Governor Nicholls	330.00	St. Andrew Street	4,804.34
Lugger Landing	4,196.28	First Street	95,594.91
Dumaine Street	110,066.77	Sixth Street	53,139.45
Toulouse Street	28,545.13	Eighth-Harmony	75,079.86
Bienville Street	11,497.81		
Poydras Street	42,394.10	Grand total	817,467.27
Girod Street	31,188.19		

Conclusions and Recommendations.

From what has already been said it is believed that the public docks of the city of New Orleans, La., can be treated in such a manner that they will be for all practical purposes rat proof. The cost of the work will not be excessive. Almost all of the necessary changes will be of material benefit in other ways than rat proofing and will greatly enhance the value of the docks. A considerable part of the work would have to be done ultimately regardless of necessity for rat proofing.

It is recommended that the work be urged as fast as conditions will permit, and that the reconstruction be begun at those docks over which most of the foodstuff is handled.

PLAGUE-PREVENTION WORK.

CALIFORNIA.

The following report of plague-prevention work in California for the week ended January 30, 1915, has been received from Passed Asst. Surg. Hurley, of the United States Public Health Service, in charge of the work: